ISSN: 2757-6817

Unika Sağlık Bilimleri Dergisi
Unika Journal of Health Sciences

Araştırma Makalesi/Research Article

Assessing Incidence of Associated Oral Complications Among Diabetic Patients

Diyabetli Bireylerde Oral Komplikasyon Görülme Sıklığının İncelenmesi

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Abstract: Objective: Aside from affecting various organs such as the eyes, kidneys, and heart, diabetes can also lead to significant complications in oral health. The aim of this research was to assess the prevalence of oral complications linked to diabetes and to evaluate the oral hygiene status of diabetic patients. Methods: 400 patients who applied to Imam Khomeini University Hospital's endocrinology department in Iran and who were between the ages of 30 and 60 and had been diagnosed with diabetes for at least two years were included in this study. A 16-item survey form was completed by volunteer patients. The Simplified Oral Hygiene Index (OHIS) was used to assess the state of oral hygiene. Results: Oral findings were observed in 88.25% of the cases. A statistically significant relationship was found between the increase in HbA1c levels and the increased frequency of oral manifestations (p=0.04). The most prevalent symptoms related to oral complications were dry mouth (57.75%) and an unpleasant taste in the mouth (22.25%). 22% of individuals reported that they used miswak (salvadora persica). In 72.5% of cases, dental hygiene was moderate. Conclusion: The prevalence of accompanying oral complications in diabetic patients was identified to be notably high. It is crucial for physicians to educate and guide patients toward achieving optimal oral hygiene to restore oral health in individuals with diabetes. Ensuring optimal oral hygiene is essential to mitigate the impact of oral complications caused by diabetes.
Keywords: Diabetes mellitus, Oral complications, HbA1c, Oral hygiene.

Öz: Amaç: Diyabetin gözler, böbrekler, kalp gibi organların yanında ağızda da çeşitli komplikasyonlara neden olduğu bilinmektedir. Bu araştırmada diyabetle ilişkili oral bulguların görülme sıklığını ve bu hastaların oral hijyen durumlarını değerlendirmek amaçlandı. Gereç ve Yöntem: Imam Khomeini Üniversite Hastanesi endokrinoloji departmanına başvuran 30-60 yaşları arasında, en az iki yıldır diyabet hastası olduğu bilinen 400 kişi çalışmaya dahil edildi. 16 soruluk bir anket gönüllü bireylerce cevaplandıktan sonra oral hijyen durumunu değerlendirmek için Basitleştirilmiş Oral Hijyen İndeksi kaydedildi. Bulgular: Bireylerin %88,25'inde oral komplikasyonların olduğu tespit edildi. Yüksek HbA1c seviyeleri ile oral bulguların görülme sıklığı arasında anlamlı ilişki bulgulandı. (p=0,04). En sık görülen bulgular ağız kuruluğu (%57,75) ve tat duyusunda değişiklik (%22,25) olarak tespit edildi. Hastaların %22'si misvak kullandığını bildirdi ve %72,5'inde oral hijyenin ortalama olduğu bulgulandı. Sonuç: Diyabete eşlik eden oral bulguların sıklığı anlamlı derecede yüksektir. Hekimlerin diyabet hastalarını optimal oral hijyeni sağlamak için yönlendirmesi ve eğitmesi oral sağlığın restore edilmesinde kritik öneme sahiptir.
Anahtar Kelimeler: Diyabet, Oral komplikasyonlar, HbA1c, Oral hijyen.

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Makale Gönderim:19.04.2024 Makale Kabul:01.08.2024 Makale Yayın:23.12.2024

Introduction

Diabetes mellitus, a widely recognized metabolic disorder, manifests through heightened levels of blood glucose. Type 1 diabetes is associated with diminished insulin secretion due to the destruction of β cells, while type 2 diabetes arises from compromised insulin secretion or resistance to its actions. (Wysham & Kirkman, 2011). Between 2006 and 2017, the global incidence of diabetes experienced a threefold increase (Atlas, 2015). Notably, in 2017, the prevalence of type 2 diabetes among adults in the Middle Eastern region, specifically in Iran, reached 8.9%, positioning it as the second highest in terms of prevalence (Lotfaliany et al., 2019). 90% of diagnosed diabetes cases are attributed to type 2 diabetes, with the remainder encompassing type 1 diabetes, immune-mediated diabetes, and gestational diabetes (American Diabetes Association, 2021a). Diabetes can lead to complications such as dehydration, impaired wound healing, myocardial infarction, stroke, ischemia, kidney failure, and retinopathy leading to blindness, neuropathy, and foot infections. Patients diagnosed with diabetes commonly encounter a heightened risk of experiencing periodontal disease, heightened caries susceptibility, xerostomia, salivary gland dysfunction, and oral infections (Emerging Risk Factors Collaboration, 2010; Indurkar et al., 2016; Kim et al., 2016).

Studies have provided evidence supporting the bidirectional relationship between periodontitis and diabetes (Demmer et al., 2012; Ship, 2003). Periodontitis is commonly described as a chronic inflammatory condition characterized by the gradual deterioration of the tissues responsible for supporting the teeth. Periodontal infections may be a predisposing factor for complications seen in diabetic patients. Elevated prevalence of periodontal disease is notably linked to poorly managed type 1 and type 2 diabetes. Additionally, diabetes correlates with increased occurrences of oral fungal infections, with fissured tongue manifestations frequently observed among affected individuals (Genco & Borgnakke, 2020). Burning in the mouth and changes in taste sensation also affect eating and drinking in diabetic patients and lead to nutritional deficiencies. Regulation of blood sugar and adequate exercise ensure diabetes control and thus ensure good oral health and control of periodontal diseases (Borgnakke et al., 2015; Genco & Borgnakke, 2020).

Individuals with uncontrolled diabetes have a localized proinflammatory environment in the gingiva that corresponds with an increase in systemic indicators of inflammation and are more likely to experience oral complications. Glycated hemoglobin levels and periodontitis may also be related and prediabetes may also be associated with an increased risk of developing periodontitis (Kocher et al., 2018). The timings of the reciprocal disease lengths of periodontitis

and diabetes are rarely studied. The findings of studies assessing the correlation between the duration of diabetes and periodontitis vary significantly.

Numerous research studies have examined the relationship between periodontal health and diabetes-related parameters, such as HbA1c, and the length of diabetes (Tsai et al., 2002). These studies indicate that factors other than the type of diabetes mellitus a patient has may have a higher impact on oral and systemic problems, including age at diabetes mellitus onset, duration of diabetes mellitus, and degree of metabolic control (Petersen & Ogawa, 2012; Roglic, 2016).

In diabetes, the likelihood of late complications is influenced by the disease's duration and the age at which it first manifests. It should be remembered that the duration of diabetes/hyperglycemia exposure is a significant influence (Zoungas et al., 2014).

Kim et al. (2013), in their research, a total of 125 patients who had been diagnosed with diabetes for longer than a year were enlisted. They categorized the duration of diabetic sickness as less than five years; 6–9 years; >10 years. As type-2 diabetes patients' diabetes duration extended, their periodontal health deteriorated. Poorer scores on periodontal health metrics were strongly correlated with longer duration of diabetes, higher fasting blood glucose and HbA1C levels. This study found a strong relationship between the length of diabetes and all periodontal measures, including Community Periodontal Index, Russell's periodontal index, missing teeth, and papillary bleeding index (Kim et al., 2013).

Sandberg et al. (2000), found no correlation between periodontitis and the length of diabetes. Despite the fact that the length of diabetes or the disease's metabolic control was unrelated to periodontal condition, individuals with longer diabetes durations had more caries lesions as did those receiving insulin treatment (Sandberg et al., 2000). There was an increase in the prevalence of periodontitis with the length of diabetes, according to reports from other research groups (Pathak et al., 2013; Rajhans et al., 2011).

Oliver et al. (1991), showed that people with insulin-dependent diabetic mellitus who have inadequate long-term management of their diabetes have more extensive and severe periodontal disease, while those with metabolic solid control have fewer periodontal issues (Oliver et al., 1991).

The aim of this research was to assess the prevalence of oral complications linked to diabetes and to evaluate the oral hygiene status of diabetic patients admitted to Imam Khomeini University Hospital in Iran.

Methods

The research was carried out at Imam Khomeini University Hospital, located in Iran. The study involved a cohort of 400 patients who sought medical attention at the endocrinology department of Imam Khomeini University Hospital in Iran and who were between the ages of 30 and 60, did not smoke or drink alcohol, had been diagnosed with diabetes for at least two years, and had at least 20 teeth in their mouth were included in this study. Patients diagnosed with autoimmune diseases, patients taking medications other than those prescribed for diabetes management, those who had undergone periodontal treatment within the preceding six months, and pregnant or lactating women were excluded from participation in the study.

The study was carried out in compliance with the Declaration of Helsinki after the Institutional Review Board evaluated and approved the survey protocol. The patients were informed about the research and a consent form was obtained. A 16-item survey form was completed by volunteer patients. The patients were asked 5 questions to record their demographic data, 3 questions about diabetes, 7 questions about oral complications, 1 question to evaluate oral hygiene habits, and the patient's oral hygiene status was examined and recorded. The assessment of oral hygiene status utilized the Simplified Oral Hygiene Index (OHI-S). This index comprises two distinct components: the Debris Index-Simplified and the Calculus Index-Simplified, each is calculated independently and then combined to derive an individual's OHI-S score. The OHI-S scores fall into three categories: fair (1.3–3.0), poor (3.1–6.0), and good (0-1.2) (Greene & Vermillion, 1964). Xerostomia evaluation involved the utilization of a dental mirror to observe its manifestation, characterized by its adherence to either the tongue or buccal mucosa. This observation served to discern the absence of saliva pooling or the presence of thick saliva.

Statistical Analysis

The data analysis was performed employing SPSS 22 statistical software. The Chi-square test was employed to investigate the significant association between HbA1c values and oral manifestations, with a significance level set at $p \leq 0.05$.

Results

A cohort comprising 400 participants (214 males and 186 females) aged between 30 and 60 years, with a mean age of 51.49 ± 5.73 years, underwent examination to assess diabetes status, oral manifestations, and oral hygiene status. In terms of education, 39 individuals (9.75%) had completed their undergraduate studies and were graduates, 294 individuals

(73.5%) had completed high school and were literate, and 67 individuals (16.75%) were illiterate. The participants in the survey had an average disease duration of 7.51 ± 3.12 (years).

Table 1 shows the relationship between the HbA1c values of the patients and the frequency of oral findings. A statistically significant relationship was found between the increase in HbA1c levels, indicating decreased diabetes control, and the increased frequency of oral manifestations (p=.04).

Table 1: The Relationship Between HbA1c Values of the Patients and The Frequency of Oral Findings

HbA1c	**n=400**	**Absence of oral findings**	**Individiuals with 1 oral findings**	**Individiuals with 2 or more oral findings**
HbA1c<6	41	29	7	5
HbA1c=6-7	85	11	43	31
HbA1c≥7	274	7	71	196

In the patients analyzed, the prevalence of oral findings was present in 88.25% of cases. As shown in Table 2, the most prevalent symptoms related to oral complications were dry mouth (57.75%) and an unpleasant taste in the mouth (22.25%). At 11.25%, the least frequent symptom was a burning feeling in the gingiva. 87 individuals (21.75%) reported experiencing tooth mobility, while 69 individuals (17.25%) reported having bad breath. Additionally, 67 individuals (16.75%) stated sensitivity in their teeth, 66 individuals (16.5%) reported swollen gums, and 47 individuals (11.75%) reported experiencing bleeding gums.

According to the questions they answered, 43.5% of the participants did not use any dental hygiene products, as indicated in Table 2. 16.75% of participants used dental floss, and 22% of individuals used miswak (salvadora persica). A total of 11% of people reported using a toothbrush while 6.75% said they used mouthwash.

Merely 23% of the subjects had good oral hygiene, as indicated by the OHIS. In 72.5% of cases, dental hygiene was moderate, and in 4.75% of cases, it was poor (Table 2).

Discussion

HbA1c is an important diagnostic marker used in individuals with diabetes, providing an indication of long-term glycemic control, typically reflecting levels from approximately three months prior (American Diabetes Association, 2021b). Dry mouth is the most prominent oral symptom of diabetes, profoundly affecting one’s quality of life. This condition not only leads to difficulties in speech but also presents challenges in chewing and swallowing, as well as in

the use of removable dentures. Moreover, it heightens susceptibility to periodontitis and peri-implantitis, increasing the risk of dental caries and eventual tooth loss (Monje et al., 2017).

Table 2: Oral Conditions and Oral Hygiene Status of the Patients

Oral complications	**n=400**	**%**
Dry mouth	231	57.75
Halitozis	69	17.25
Swollen gum	66	16.5
Tooth hypersensitivity	67	16.75
Tooth mobility	87	21.75
Unpleasant taste	89	22.25
Burning mouth/tongue	46	11.5
Gingival bleeding	47	11.75
Oral hygiene tools		
Toothbrush	44	11
Dental woodsticks (miswak)	88	22
Dental floss	67	16.75
Mouthwash	27	6.75
None of the above	174	43.5
OHIS		
Good	92	23
Fair	289	72.25
Poor	19	4.75

Medications prescribed to diabetic patients may also contribute to the occurrence of dry mouth (Borgnakke et al., 2021). It has been found that dry mouth is more frequently observed in patients with high HbA1c levels (Chávez et al., 2001). Diabetic neuropathy can lead to decreased saliva flow, burning mouth, and alterations in taste perception (Borgnakke et al., 2015). A study involving diabetic patients aged between 65 and 91 revealed a significant decrease in saliva flow by 92.5% (Lima et al., 2017). Additionally, a meta-analysis indicated that diabetic individuals had a higher incidence of xerostomia, at 46.09%, and exhibited reduced saliva flow compared to those without diabetes (Lessa et al., 2015). In a study conducted to assess the severity of xerostomia in individuals with insulin-dependent diabetes, a notable relationship between the severity of dry mouth and the concentration of glucose in saliva was observed (Ivanovski et al., 2012). In our study, consistent with previous findings, dry mouth emerged as the predominant oral complication, observed in 57.75% of the patients. These findings further substantiate the significance of dry mouth as one of the leading factors contributing to oral complications in diabetes.

Halitosis is also an oral manifestation associated with elevated HbA1c levels (Choi, 2020). Similar to the findings, our study also found a significant increase in the frequency of oral symptoms such as dry mouth and halitosis in patients with high HbA1c levels.

Burning mouth syndrome frequently accompanies dry mouth and unpleasant taste, impacting a diverse spectrum of individuals (Gurvits & Tan, 2013). In a study, a greater prevalence of taste alterations was found among individuals with diabetes (Stolbova et al., 1999). Diabetes is known to increase the risk of developing burning mouth syndrome, a condition marked by oral discomfort (Grushka et al., 2002). The burning sensation, frequently accompanied by an unpleasant taste and other sensory distortions, is attributed to neuropathic mechanisms. Therefore, patients affected by peripheral diabetic neuropathy exhibit an increased susceptibility to experiencing burning mouth sensations (Coculescu et al., 2014; Gandara & Morton Jr, 2011). In the current study, alterations in taste were found as the second most prevalent complication, occurring at a rate of 22.25%. In contrast to previous findings, burning mouth syndrome was the least frequently reported symptom, with a rate of 11.5%. This may occur due to factors such as failure to recognize the symptoms of the syndrome or confusing the burning sensation with other symptoms. Moreover, some patients may experience symptoms but may have difficulty in identifying them. Such variables may have hindered the precise identification of the syndrome in this study, thus potentially impacting the reported frequencies of symptoms.

Periodontal disease stands as the foremost etiological factor behind tooth mobility and eventual tooth loss in adult populations. While periodontal diseases may advance silently, manifestations such as gingival bleeding and swelling are discernible indicators of their progression (Fischer et al., 2020). Effective management of periodontal conditions is essential and pivotal for maintaining appropriate control over diabetes. In this study, only 66 individuals (16.5%) reported swelling, and 47 individuals (11.75%) reported experiencing bleeding gums. These complaints were relatively less prevalent. This could be because some individuals may alleviate or not notice symptoms in the early stages of periodontal disease, or some individuals may not notice or pay attention to symptoms such as gum swelling or bleeding.

Soofi et al. (2020), in their study evaluating the oral hygiene habits of middle-aged and older adults across 14 regions in Iran, found a notably low prevalence of the recommended oral health practices of brushing teeth twice daily and using dental floss once daily. Additionally, they observed lower scores in oral hygiene habits with decreasing socioeconomic status. They attributed this phenomenon to the more frequent use of miswak and mouthwash compared to toothbrushing. However, they noted the absence of a nationwide study examining the use of miswak (Soofi et al., 2020). Previous survey studies conducted in various age groups in Iran have found poor oral hygiene (Asgari et al., 2015; Kasmaei et al., 2014).

In the current study, 43.5% of the participants did not utilize any dental hygiene products, while 16.75% reported using dental floss. Notably, 22% of individuals employed miswaks for oral hygiene maintenance. Interestingly, only 11% of people reported using a toothbrush, with a total of 6.75% indicating the use of mouthwash. In our study, the assessment of oral hygiene status was conducted using the Simplified Oral Hygiene Index (OHI-S). Merely 23% of the subjects demonstrated good oral hygiene based on the OHIS criteria. In 72.5% of cases, dental hygiene was categorized as moderate, while 4.75% of cases exhibited poor hygiene. The reason for not finding poor oral hygiene as in other studies could be attributed to the mean age of 51 years in our study or the relatively higher socioeconomic status of the individuals.

One of the limitations of the study is that the assessment of oral complications and oral hygiene practices in diabetic individuals was self-reported, which may be affected by individual knowledge and the ability to perceive and distinguish complications. Another limitation is the sole utilization of the OHIS for assessing oral hygiene, without concurrent evaluation of periodontal status during the administration of the questionnaire. An additional limitation in our research is that the evaluation of xerostomia was conducted solely through the use of a dental mirror to see its appearance, which is typified by adherence to the tongue or buccal mucosa, without the help of other objective techniques such as measuring salivary flow rate.

Conclusion

According to the findings of our study, the prevalence of accompanying oral complications in diabetic patients was identified to be notably high, reaching an incidence rate as high as 88.25%. Particularly, dry mouth emerged as the most commonly reported symptom. Our study reveals that 68.5% of patients exhibited HbA1c levels surpassing 7, indicative of poor metabolic control. Additionally, uncontrolled HbA1c levels may limit the efficacy of periodontal treatment. Enhancing oral health in diabetic individuals can be achieved through regular oral assessments conducted by dentists during routine check-ups. It is crucial for physicians to educate and guide patients to achieve optimal oral hygiene to restore oral health in individuals with diabetes. Ensuring optimal oral hygiene is essential to mitigate the impact of oral complications caused by diabetes.

Funding: No external funding was obtained for this research.

Ethical Statement: This study was conducted with the approval of the Research Ethics Committees of Urmia University of Medical Sciences (Decision No: 2023/08.09).

Conflict of interest: The authors have disclosed no conflicts of interest.

Author Contributions: Idea: SM, BK; Design: SM, HRM; Check: BK; Sources: SM, HRM; Ingredients: SM, HRM; Data collecting: SM; Analysis: SM; Literature Review: SM, BK; Posted by: SM; Critical Review: BK, HRM.

Peer Review: Internal/External independent.

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